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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/761,256

01/22/2004

Takashi Tonegawa

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02/06/2006

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EXAMINER

NGUYEN, THANH T

ART UNIT

PAPER NUMBER

2813

DATE MAILED: 02/06/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/761,256

Applicant(s)

TONEGAWA, TAKASHI

Examiner

Thanh T. Nguyen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 15 November 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-11 is/are pending in the application.
- 4a) Of the above claim(s) 7-11 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-6 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

Applicant's arguments filed 11/15/05 have been fully considered but they are not persuasive.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-6 are stand rejected under 35 U.S.C. 102(e) as being anticipated by Chambers et al. (U.S. Publication No. 2003/0137050) as previously applied.

Referring to figures 1-8, Chambers et al. teaches a semiconductor device comprising a first Cu interconnection (see figure 1) including additive metal atoms (see paragraphs# 26, 32) and additive silicon atoms (see paragraphs# 35, 47, 58), wherein a density of said additive metal atoms is higher in vicinities of bottom and side surfaces of said first Cu interconnection than in a vicinity of a top surface (see paragraphs# 26, 32) thereof, and a density of said additive silicon atoms is higher in said vicinity of said top surface than in said vicinities of said bottom and side surfaces (see paragraphs# 35, 47, 58). Noted that the same process would provide the same

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results such that seed layer is formed comprising copper and other alloy metals and anneal at the temperature of 200-400°C. and exposing the copper (conductive) layer with silane and annealing at the temperature of 300-450 to prevent the formation of silicide to improve electromigration reliability (see paragraphs# 26/32, 35/47/58).

Regarding to claim 2, additive metal atoms include atoms of one or more of metals selected from the group consisting of Al, Sn, Ti, Si, In, Ag, Zr, Ni, Mg, Be, Pd, Co, B, Zn, Ca, Au and Ga (see paragraph# 26).

Regarding to claim 3, a second Cu interconnection (see figure 1, metallization layer 1) overlying said first Cu interconnection (metallization layer 2) and including additive metal atoms and additive silicon atoms, wherein a density of said additive metal atoms in said second Cu interconnection is higher in vicinities of bottom and side surfaces of said first Cu interconnection than in a vicinity of a top surface thereof, and a density of said additive silicon atoms in said second Cu interconnection is higher in said vicinity of said top surface than in said vicinities of said bottom and side surfaces (see figure 1-8, paragraphs# 26/32, 35/47/58).

Regarding to claim 4, additive metal atoms in said second Cu interconnection include atoms of one or more of metals selected from the group consisting of Al, Sn, Ti, Si, In, Ag, Zr, Ni, Mg, Be, Pd, Co, B, Zn, Ca, Au and Ga (see paragraph# 26).

Regarding to claim 5, second Cu interconnection includes a Cu interconnection line and a via plug extending from said Cu interconnection line and connected to said first Cu interconnection (see figure 1).

Regarding to claim 6, the first Cu interconnection and said second Cu interconnection are connected together via a Cu plug covered with a barrier metal film (300, see figure 1+).

Response to Arguments

Applicant's arguments filed 11/15/05 have been fully considered but they are not persuasive.

Applicant contends that Chambers does not teaches the distribution of the metal and silicon atom to have the density of the silicon highest at the top surface of the interconnect, and the density of the metal highest at the bottom and the side surfaces of the copper interconnect. In response to applicant that Chambers clearly teaches that the copper interconnect (barrier layer/seed layer/ and the copper layer) having the copper alloy seed (see paragraph# 26) which include the additive metal wherein the seed layer is known to form at the bottom and the side surfaces of the copper interconnect. Implanting (doping) the silicon into the interconnect (see paragraph# 35/47/58) to have the density of the silicon highest at the top surface of the interconnect.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,


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however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh Nguyen whose telephone number is (571) 272-1695, or by Email via address Thanh.Nguyen@uspto.gov. The examiner can normally be reached on Monday-Thursday from 6:00AM to 3:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, can be reached on (571) 272-1702. The fax phone number for this Group is (571) 273-8300.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956 (See **MPEP 203.08**).



Thanh Nguyen
Patent Examiner
Patent Examining Group 2800

TTN